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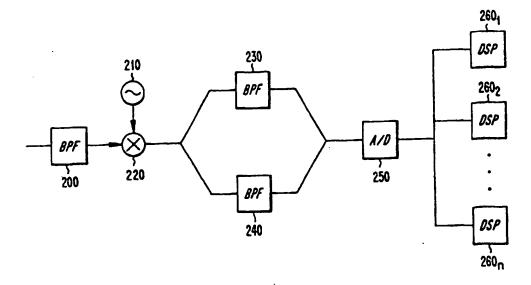
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(54) Title: AMPS A-BAND SINGLE SUPERHET

(57) Abstract

A wideband receiver is provided for fully covering a desired band with only one mixer and one local oscillator. The wideband receiver advantageously utilizes the inherent aliasing characteristics of the sampling process taking place in the analog-to-digital converter to achieve full coverage of the desired band. More particularly, the wideband receiver is directed to fully covering the A-band of the AMPS frequency plan by analog-to-digitally converting two separate parts of a spectrum input to the wideband receiver where said spectrum has a total bandwidth greater than the Nyquist frequency of the analog-to-digital converter without any individual frequency transposition of each spectra part before being input to the analog-to-digital converter. The analog-to-digital converter aliases the transposed desired separate frequency bands to fulfill the Nyquist criteria even when a sampling frequency of the analog-to-digital converter is less than twice the bandwidth of the spectrum. As a result, the wideband receiver minimizes the number of analog parts used so that the wideband receiver is smaller, consumes less power and has a higher manufacturing yield.

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AMPS A-BAND SINGLE SUPERHET
BACKGROUND

The present invention is directed to a wideband
receiver for providing full coverage of a desired band
5   by advantageously utilizing aliasing characteristics of
the sampling process. More particularly, the present
invention is directed to a device and method for a
wideband single superheterodyne (superhet) receiver for
full A-band coverage in the Advanced Mobile Phone
10   Service (AMPS) frequency plan with only one mixer and
one local oscillator.

Presently, base station receivers for AMPS and D-
AMPS are usually designed as double superheterodyne
receivers which perform an analog downconversion of each
15   individual narrowband (approximately 30 kHz) channel to
a fixed (common for all channels) intermediate
frequency. In other words, the same fixed intermediate
frequency is used irrespective of which channel the
receiver is tuned to. Analog-to-digital conversion of
20   each narrowband channel is then performed and subsequent
signal processing is done digitally.

An example of a conventional double superheterodyne
receiver system for n channels is illustrated in Figure
1. In Figure 1, desired bands are received by a first
25   bandpass filter 10 which is connected to first pairs of
first local oscillators 20_1, 20_2, ...20_n and first mixers
30_1, 30_2, ...30_n so that each received channel is
converted to a common fixed intermediate frequency. A
plurality of second bandpass filters 40_1, 40_2, ...40_n are
30   connected to the first mixers 30_1, 30_2, ...30_n,
respectively for passing through narrowband channels of
approximately 30 kHz. The outputs of the second
bandpass filters 40_1, 40_2, ...40_n are connected to second
pairs of second local oscillators 50_1, 50_2, ...50_n and

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second mixers 60_1, 60_2, ...60_n for performing an analog
down conversion of each individual narrowband channel
from the second bandpass filters 40_1, 40_2, ...40_n. The
outputs of the second mixers 60_1, 60_2, ...60_n are

5   connected to a plurality of third bandpass filters 70_1,
70_2, ...70_n. Analog-to-digital converters 80_1, 80_2, ...80_n
perform analog-to-digital conversion of each narrowband
channel and then signal processing is performed
digitally by a plurality of digital signal processors

10   90_1, 90_2, ...90_n.

It is also known to use a wideband receiver in
which the whole frequency spectra allocated to the
operator is downconverted to a suitable intermediate
frequency interval and then converted from analog to

15   digital. The selection of each narrowband channel and
further processing is then done digitally. Figure 2
illustrates an example of this conventional wideband
receiver where a signal is input to a first bandpass
filter 15 and then downconverted to the intermediate

20   frequency interval by a local oscillator 25 and a mixer
35. The output of the mixer 35 is input to a second
bandpass filter 45 and then converted to a digital
signal by the analog-to-digital converter 85. The
output of the analog-to-digital converter 85 is input to

25   a plurality of digital signal processors 95_1, 95_2, ...95_n
for further processing.

In the application of wideband receivers to the
AMPS frequency plan, certain difficulties exist which
prevent sufficient resolution from being achieved for

30   the required dynamic range of the wideband receiver. To
better illustrate these problems, an overview of the
AMPS frequency is provided below in Table 1.

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TABLE 1

A''	824-825 MHz	(1 MHz bandwidth)
A	825-835 MHz	(10 MHz)
B	835-845 MHz	(10 MHz)
A'	845-846.5 MHz	(1.5 MHz)
B'	846.5-849 MHz	(2.5 MHz)

As seen in Table 1, the full A- or B-band utilizes
12.5 MHz bandwidth each. Because of the distribution of
the bands, a wideband receiver needs to cover 22.5 MHz
10   bandwidth (824-846.5 MHz) for the full A-band and 14 MHz
bandwidth for full B-band coverage (835-849 MHz),
respectively. Because only the A- and B-bands were
originally allocated for mobile telephone use, the later
addition of the extended bands A''-, A'- and B'-bands
15   caused the differences in the bandwidth which are
necessary for fully covering the A- and B-bands.

To achieve full B-band coverage in a wideband
receiver, a sampling frequency of at least 28 MHz (2 x
14 MHz, which is the bandwidth for full B-band coverage)
20   is needed. The 28 MHz sampling frequency is within the
limits of the present technology for sufficient
resolution to achieve the required dynamic range for the
wideband receiver. However, to achieve full A-band
coverage, a sampling frequency of more than 45 MHz (2 x
25   22.5 MHz, the bandwidth for full A-band coverage) is
required. This sampling frequency is beyond the present
technology for an analog-to-digital converter with
sufficient resolution.

In order to overcome this problem of insufficient

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resolution, a wideband receiver as illustrated in Figure
3, for example, has been proposed. In the wideband
receiver of Figure 3, a first bandpass filter 100
receives the A''-, A'- and A-bands and is connected to a
5   pair of first local oscillator 110 and a first mixer 120
which frequency transpose the A-, A'-, and A''-bands to
an intermediate frequency band. The output of the first
mixer 120 is connected to second and third bandpass
filters 130 and 131 for passing the A- and A''-bands and
10   the A'-band therethrough, respectively. The outputs of
the second and third bandpass filters 130 and 131 are
connected to pairs of second and third local oscillators
140 and 141 and second and third mixers 150 and 151.
The outputs of the second and third mixers 150 and 151
15   are input to fourth and fifth bandpass filters 160 and
161, respectively. The frequency of the second local
oscillator 140 and the frequency of the third local
oscillator 141 are chosen so that the A''- and A-bands,
and the A'-band, respectively, are transposed to a
20   nearly continuous frequency band having a total
bandwidth of less than approximately 15 MHz. As a
result, the required sampling frequency becomes 30 MHz
(2 x the total bandwidth of approximately 15 MHz). The
nearly continuous frequency band is input to an analog-
25   to-digital converter 170. The output of the analog-to-
digital converter 170 is input to a plurality of digital
signal processors 180_1, 180_2, ...180_n. The frequencies of
the second and third local oscillators 140 and 141 must
be chosen so that a sufficient guardband is provided
30   which prevents the requirements on the anti-aliasing
filters from being too stringent.
        Figure 4 illustrates another proposed solution
which provides a sufficient resolution for the required
dynamic range of the wideband receiver. In Figure 4, a
35   first bandpass filter 105 receives the A-, A'-, and A''-

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bands and passes these bands through to a pair of a
local oscillator 115 and a first mixer 125. The
transposed A- and A''-bands are input to a second
bandpass filter 135 and the transposed A'-band is input
5   to a third bandpass filter 136. The outputs of the
second and third bandpass filters 135 and 136 are input
to second and third mixers 155 and 156 which are
connected to a common local oscillator 145 so that F_{in}-
F_{LO} from one mixer and F_{LO}- F_{in} from the other mixer are
10   used. The outputs of the second and third mixers 155
and 156 are input to fourth and fifth bandpass filters
165 and 166 to provide a nearly continuous frequency
band to an analog-to-digital converter 175. The output
of the analog-to-digital converter 175 is input to a
15   plurality of digital signal processors 185_1, 185_2,
...185_n. In this wideband receiver, one of the bands is
inverted, while the other band is non-inverted, but the
inverted band is corrected by the digital signal
processors 185_1, 185_2, ...185_n.
20   In both of the wideband receivers proposed in
Figures 3 and 4, a double superhet receiver is used with
three mixers and at least two local oscillators. The
embodiments of the present invention are directed to a
wideband single superheterodyne receiver which fully
25   covers a desired band with only one mixer and one local
oscillator.

SUMMARY

An object of the present invention is to provide a
wideband receiver which fully covers a desired bandwidth
30   of frequencies. More particularly, the present
invention is directed to a wideband superheterodyne
receiver for providing full coverage of the desired band
with only one mixer and one local oscillator.

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Another object of the present invention is to
utilize an analog-to-digital converter which converts
two separate parts of a spectrum, where said spectrum
has a total bandwidth greater than the Nyquist frequency
5   of the analog-to-digital converter, and to take
advantage of the aliasing characteristics during the
sampling process in a positive manner so that the
wideband receiver provides full coverage of the desired
band.
10   A still further object of the present invention is
to provide full A-band coverage of the AMPS frequency
plan by a wideband receiver having only one mixer and
one local oscillator.
These objects of the present invention are
15   fulfilled by providing a wideband receiver for full
coverage of a desired band comprising a local oscillator
operating at a transposing frequency, a mixer connected
to said local oscillator for receiving predetermined
frequency bands and transposing said predetermined
20   frequency bands to transposed frequency bands in
response to said transposing frequency, and an analog-
to-digital converter operating at a sampling frequency
for aliasing down said transposed frequency bands to
achieve full coverage of the desired band. By using the
25   aliasing characteristics of the analog-to-digital
converter in a positive manner, the wideband receiver
provides full A-band coverage with only one mixer and
one local oscillator. Thereby the analog parts of the
wideband receiver are minimized so that the wideband
30   receiver is smaller in size, consumes less power and has
a high manufacturing yield.
The objects of the present invention are also
fulfilled by a method for providing full coverage of a
desired band with a wideband receiver comprising the
35   steps of operating a local oscillator at a transposing

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frequency, receiving predetermined frequency bands with
a mixer and transposing said predetermined frequency
bands to transposed frequency bands in response to said
transposing frequency, and aliasing down said transposed
5   frequency bands by an analog-to-digital converter
operating at a sampling frequency to achieve full
coverage of the desired band. This method similarly
utilizes the inherent aliasing characteristics of this
sampling process taking place in the analog-to-digital
10 converter so that full coverage of a desired band is
provided with only one mixer and one local oscillator.
Further scope of applicability of the present
invention will become apparent from the detail
description given hereinafter. However, it should be
15 understood that the detailed description and specific
examples, all indicating preferred embodiments of the
invention, are given by way of illustration only, since
various changes and modifications within the spirit and
scope of the invention will become apparent to those
20 skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully
understood from the detailed description given
hereinbelow and the accompanying drawings which are
25 given by way of illustration only, and thus are not
limitative of the present invention, wherein:
Figure 1 illustrates a conventional receiver system
for n narrowband channels where each channel is
processed in a double superheterodyne receiver which
30 converts each narrowband channel;
Figure 2 illustrates a conventional wideband
receiver which converts the whole frequency spectra and
performs digital processing for n narrowband channels;
Figure 3 illustrates a proposed wideband receiver
35 having three mixers and three local oscillators, making

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it possible to convert two separate parts of a spectrum
into a nearly continuous frequency band with a bandwidth
less than the original spectrum bandwidth;

Figure 4 illustrates a proposed wideband receiver
5   having three mixers and two local oscillators, making it
possible to convert two separate parts of a spectrum
into a nearly continuous frequency band with a bandwidth
less than the original spectrum bandwidth;

Figure 5 illustrates a wideband receiver for an
10   embodiment of the present invention; and

Figure 6 illustrates an example of a frequency plan
for the wideband receiver used in an embodiment of the
present invention.

<u>DETAILED DESCRIPTION</u>

15   Figure 5 illustrates a wideband receiver for an
embodiment of the present invention. In this
embodiment, a wideband, single superheterodyne receiver
is provided for full coverage of a desired band with
only one mixer and one local oscillator. In Figure 5, a
20   spectrum is input to a first bandpass filter 200 which
passes through desired frequency bands. The desired
frequency bands passing through the first bandpass
filter 200 are input to a mixer 220. The mixer 220 is
connected to a local oscillator 210 which operates the
25   mixer 220 at a transposing frequency. By operating the
mixer 220 at the transposing frequency, transposed
frequency bands are outputted from the mixer 220. The
output of the mixer 220 is input to second and third
bandpass filters 230 and 240 for passing the transposed
30   frequency bands therethrough. The transposed frequency
bands are input to an analog-to-digital converter 250
which converts the transposed frequency bands to digital
signals.

In the sampling process, the analog-to-digital
35   converter 250 operates at a predetermined sampling

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frequency which aliases down the transposed frequency
bands to inverted and non-inverted frequency bands. The
output of the analog-to-digital converter 250 is input
to a plurality of digital signal processors 260_1, 260_2,

5 ...260_n for further processing of the frequency bands.
The digital signal processors 260_1, 260_2, ...260_n can
easily process the inverted frequency band aliased down
by the analog-to-digital converter 250. For simplicity,
only the parts that are essential for the understanding

10 of the function are shown in the figures and mentioned
in the description (the filters, mixers, local
oscillators, analog-to-digital converters). However, in
the actual implementation of the wideband receiver,
various additional circuitry as would be obvious to one

15 of ordinary skill in the art is necessary to ensure that
sufficient signal-to-noise ratios are achieved, such as
different amplifiers for example.

In the present embodiment, aliasing, which is
usually thought of as an undesired property, is used in

20 a positive manner to make it possible to design a
wideband receiver for fully covering a desired band in a
spectrum with only one mixer and one local oscillator.
The analog input spectra consists of two desired parts
with bandwidths B_1 and B_2 respectively, separated by a

25 non-desired band with bandwidth G_a, where $B_1 + G_a + B_2 >
f_{Nyq}$, and where f_{Nyq} is the Nyquist frequency of the
analog-to-digital converter 250. The aliasing is used
to digitally transpose the part with the bandwidth B_2 so
that the digital (after analog-to-digital conversion)

30 spectra consists of two desired parts with bandwidths B_1
and B_2 respectively, now separated by a non-desired band
with bandwidth G_d, where $B_1 + G_d + B_2 < f_{Nyq}$. By
advantageously utilizing the aliasing characteristics of
the analog-to-digital converter 250, a sampling

35 frequency can be used that is within the known

limitations for present analog-to-digital converters
(approximately 39 MHz). Thereby, even when the·sampling
frequency is less than twice the bandwidth of the
spectrum, the Nyquist criteria is fulfilled by
5   advantageously utilizing the aliasing characteristics.

When the desired band coverage is for the A-band of
the AMPS frequency plan, for example, the wideband
single superheterodyne receiver operates as will be
described as follows with reference to Figure 6. This
10   example is used to only illustrate the operation of the
wideband receiver for the present embodiment and other
considerations must be taken into account when actually
designing the wideband receiver, such as sample
frequency versus data rate, anti-aliasing filter
15   structures, etc., which are neglected in this example.
The full A-band is input to the first bandpass filter
200 for passing through the A''-, A-, and A'-bands which
include the frequencies of 824-835 and 845-846.5 MHz.
These frequency bands are then input to the mixer 220
20   which is operated by the local oscillator 210 at the
transposing frequency of 803 MHz and transposes the A''-
and A-bands to between the frequencies of f_1 and f_2
(corresponding to 21 and 32 MHz) and the A'-band to
between the frequencies of f_3 and f_4 (which corresponds
25   to 42 and 43.5 MHz) as illustrated in Figure 6. The
second bandpass filter 230 passes through the A- and
A''-bands between 21 and 32 MHz and the third bandpass
filter 240 passes through A'-band frequencies between 42
and 43.5 MHz.
30   With a sampling frequency of f_S = 39 MHz for the
analog-to-digital converter 250, the A'-band is aliased
down to between 3 and 4.5 MHz (non-inverted) and the
A''- and A-bands are aliased down to between 7 and 18
MHz, inverted. Although it is theoretically possible to
35   use a sampling frequency of approximately 33.5 MHz in

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this example, the sampling frequency should be higher, near the 39 MHz used in this example, for practical purposes to provide a sufficient guardband. The theoretical minimum sampling frequency can be calculated

5   as follows. By placing f_S between f_2 and f_3 so that $f_3 - f_S = f_S - f_2 - (f_4 - f_3)$ [Equation 1] the "A'-band of the spectrum is made to alias around f_S without overlapping the A''- and A-bands. The A''- and A-bands alias around f_1 such that $f_1 = f_S/2$ [Equation 2]. Thereby, Equation 1

10   can be rewritten as $2f_S = f_2 + f_4 = f_2 - f_1 + f_4 - f_1 + 2f_1$ [Equation 3]. Because $2f_1 = f_S$ according to Equation 2, the relation $f_S = f_2 - f_1 + f_4 - f_1 = 11$ MHz + 22.5 MHz = 33.5 MHz for this example. The aliased down A-band is included within the frequencies from 3 to 18 MHz with a

15   guardband between 4.5 and 7 MHz. The A- and A''-bands are inverted while the A'-band is non-inverted, but the A- and A''-bands are easily processed by the digital signal processors 260_1, 260_2, ... 260_n which receive the output from the analog-to-digital converter 250.

20   By utilizing the inherent aliasing characteristics of the sampling process which takes place in the analog-to-digital converter 250, a wideband superheterodyne receiver is provided for full A-band coverage with only one mixer and one local oscillator. More generally, by

25   advantageously using the aliasing characteristics, a wideband receiver may be designed for fully covering a desired band with only one mixer and one local oscillator. As a result, the analog parts of the wideband receiver are minimized so that the wideband

30   receiver is smaller, consumes less power, has a higher manufacturing yield and has a reduced manufacturing cost.

      The invention being thus described, it would be obvious that the same may be varied in many ways. Such

35   variations are not to be regarded as a departure from

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the spirit and scope of the invention, and all such
modification as would be obvious to one skilled in the
art are intended to be included within the scope of the
following claims.

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<u>CLAIMS</u>:

1. A wideband receiver for providing full coverage of desired separate frequency bands in a spectrum, comprising:

5   a local oscillator operating at a transposing frequency;

a mixer connected to said local oscillator for receiving the spectrum and transposing the spectrum to a transposed spectrum in response to said transposing

10   frequency; and

an analog-to-digital converter for aliasing said transposed spectrum of the desired separate frequency bands to fulfill the Nyquist criteria when a sampling frequency of said analog-to-digital converter is less

15   than twice the bandwidth of the spectrum.

2. A wideband receiver according to claim 1, further comprising a first bandpass filter for receiving the spectrum having a plurality of frequency bands and passing through the desired separate frequency bands.

20   3. A wideband receiver according to claim 1, further comprising a plurality of second bandpass filters for passing through said transposed spectrum.

4. A wideband receiver according to claim 1, wherein the desired separate frequency bands comprise A-

25   , A'- and A''-bands of the full A-band for the AMPS frequency plan.

5. A wideband receiver according to claim 4, wherein said analog-to-digital converter aliases down said A- and A''-bands together in an inverted manner and

30   aliases down said A'-band in a non-inverted manner.

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6.   A wideband receiver according to claim 5,
further comprising a plurality of digital signal
processors for inverting said A- and A''-bands and
processing said A-, A'- and A''-bands.

5   7.   A wideband receiver according to claim 1,
further comprising a plurality of digital signal
processors for processing said transposed spectrum after
being aliased down by said analog-to-digital converter.

8.   A wideband receiver according to claim 1,
10   wherein the desired separate frequency bands are
allocated in the spectrum where said spectrum has a
total bandwidth greater than the Nyquist frequency of
said analog-to-digital converter and the wideband
receiver is a wideband single superheterodyne receiver.

15   9.   A wideband receiver comprising:
a local oscillator operating at a transposing
frequency;
a mixer connected to said local oscillator for
transposing a spectrum of first and second bandwidths to
20   a transposed spectrum of said first and second
bandwidths in response to said transposing frequency;
and
an analog to digital converter for aliasing said
transposed spectrum of said first and second bandwidths
25   to fulfill the Nyquist criteria when a sampling
frequency of said analog-to-digital converter is less
than twice the bandwidth of the spectrum.

10.   A wideband receiver according to claim 9,
wherein said first bandwidth comprises A- and A''-bands
30   and said second bandwidth comprises an A'-band to
provide full A-band coverage of the AMPS frequency plan.

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11. A wideband receiver according to claim 9,
further comprising:

a first bandpass filter for passing through said
spectrum of said first and second bandwidths to said
5   mixer; and

a second bandpass filter for passing through said
transposed spectrum of said first and second bandwidths
from said mixer to said analog-to-digital converter.

12. A wideband receiver according to claim 9,
10   wherein said analog-to-digital converter aliases down
said transposed spectrum for said first bandwidth in an
inverted manner and said transposed spectrum for said
second bandwidth in a non-inverted manner.

13. A wideband receiver according to claim 9,
15   further comprising a plurality of digital signal
processors for inverting said transposed spectrum for
said first bandwidth and processing said transposed
spectrum for said first and second bandwidths.

14. A wideband receiver for providing full A-band
20   coverage of the AMPS frequency plan, comprising:

a local oscillator operating at a transposing
frequency;

a mixer connected to said local oscillator for
receiving a spectrum of A-, A'- and A''-bands for the A-
25   band and transposing said spectrum for said A- and A''-
bands to a first transposed spectrum and said spectrum
for said A'-band to a second transposed spectrum; and

an analog-to-digital converter for aliasing said
first and second transposed spectrums for fulfill the
30   Nyquist criteria when a sampling frequency of said
analog-to-digital converter is less than twice the
bandwidth of said spectrum.

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15.   A wideband receiver according to claim 14,
wherein said analog-to-digital converter aliases down
said first transposed spectrum to an inverted spectrum
and said second transposed spectrum to a non-inverted
5   spectrum.

16.   A wideband receiver according to claim 14,
further comprising:
      a first bandpass filter for passing through said
spectrum of said A-, A'- and A''-bands to said mixer;
10   a second bandpass filter for passing through said
first transposed spectrum from said mixer to said
analog-to-digital converter; and
      a third bandpass filter for passing through said
second transposed spectrum from said mixer to said
15   analog-to-digital converter.

17.   A method for providing full coverage of
desired separate frequency bands in a spectrum by a
wideband receiver, comprising the steps of:
      (a) operating a local oscillator at a transposing
20   frequency;
      (b) receiving the spectrum and transposing the
spectrum to a transposed spectrum in response to said
transposing frequency by a mixer; and
      (c) aliasing said transposed spectrum of the
25   desired separate frequency bands by an analog-to-digital
converter to fulfill the Nyquist criteria when a
sampling frequency of said analog-to-digital converter
is less than twice the bandwidth of the spectrum.

18.   A method according to claim 17, further
30   comprising the steps of:
      (d) receiving the spectrum having a plurality of
frequency bands by a first bandpass filter and passing

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through the desired separate frequency bands to said
mixer; and

(e) receiving said spectrum from said mixer by a
second bandpass filter and passing through the desired
5   separate frequency bands to said analog-to-digital
converter.

19.   A method according to claim 17, wherein the
spectrum comprises a first frequency band for A- and
A''-bands and a second frequency band for an A'-band of
10   the full A-band for the AMPS frequency plan.

20.   A method according to claim 19, wherein said
step (c) aliases down said first frequency band in an
inverted manner and said second frequency band in a non-
inverted manner.

15   21.   A method according to claim 20, further
comprising the steps of inverting said first frequency
band and processing said first and second frequency
bands by a plurality of digital signal processors.

22.   A method for providing full coverage of
20   desired separate frequency bands in a spectrum by a
wideband receiver comprising the steps of:

(a) operating a local oscillator at a transposing
frequency;

(b) receiving the spectrum of first and second
25   bandwidths and transposing the spectrum of said first
and second bandwidths to a transposed spectrum of said
first and second bandwidths in response to said
transposing frequency;

(c) aliasing said transposed spectrum of said first
30   and second bandwidths by an analog-to-digital converter
to fulfil the Nyquist criteria when a sampling frequency

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of said analog-to-digital converter is less than twice the bandwidth of the spectrum.

23. A method according to claim 22, wherein said first bandwidth comprises A- and A''-bands and said
5   second bandwidth comprises an A' band to provide full A- band coverage of the AMPS frequency plan.

24. A method according to claim 22, further comprising the steps of:
    (d) receiving the spectrum of said first and second
10   bandwidths and passing through said first and second bandwidths to said mixer; and
    (e) receiving said transposed spectrum of said first and second bandwidths from said mixer and passing through said transposed spectrum of said first and
15   second bandwidths from said mixer to said analog-to- digital converter.

25. A method according to claim 22, wherein said step (c) aliases down said transposed spectrum for said first bandwidth in an inverted manner and aliases down
20   said transposed spectrum for said second bandwidth in a non-inverted manner.

26. A method according to claim 22, further comprising the steps of inverting said transposed spectrum for said first bandwidth and processing said
25   transposed spectrum for said first and second bandwidths by a plurality of digital signal processors.

27. A method for providing full A-band coverage of the AMPS frequency plan by a wideband receiver comprising the steps of:
30   (a) operating a local oscillator at a transposing

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frequency;
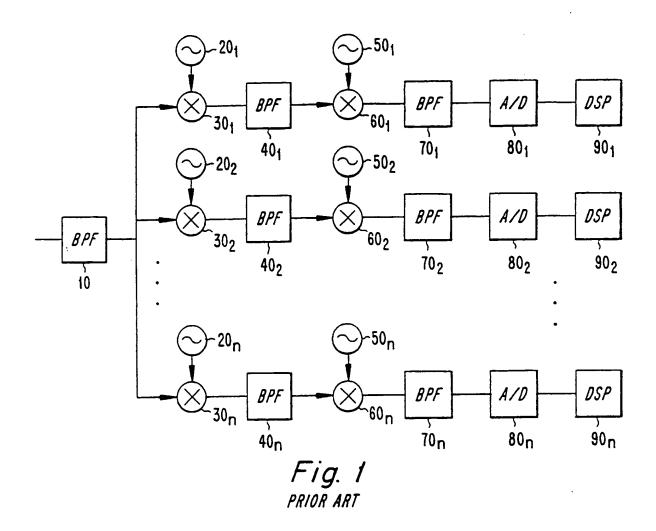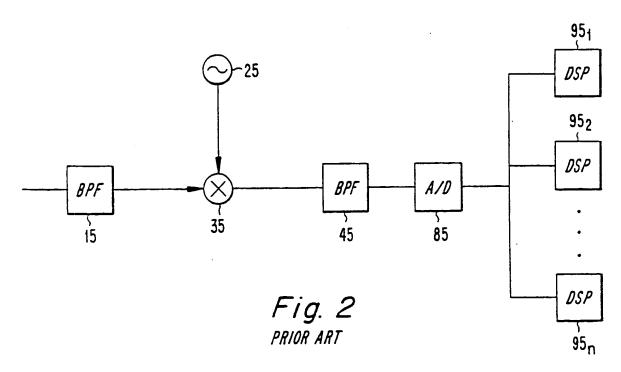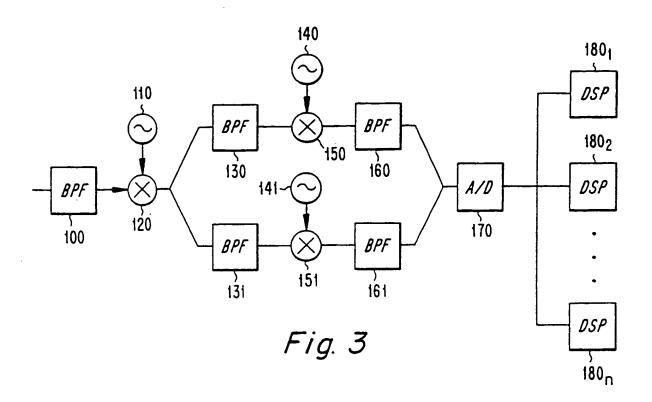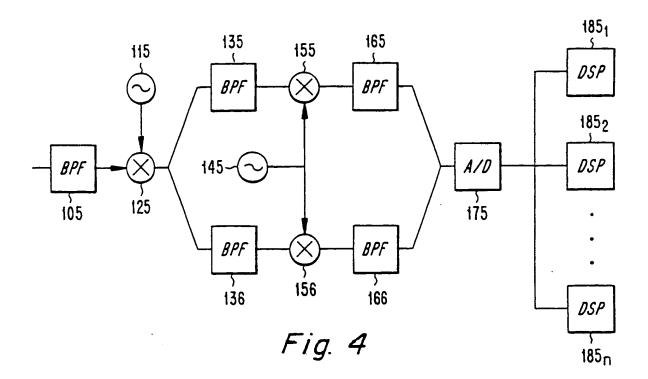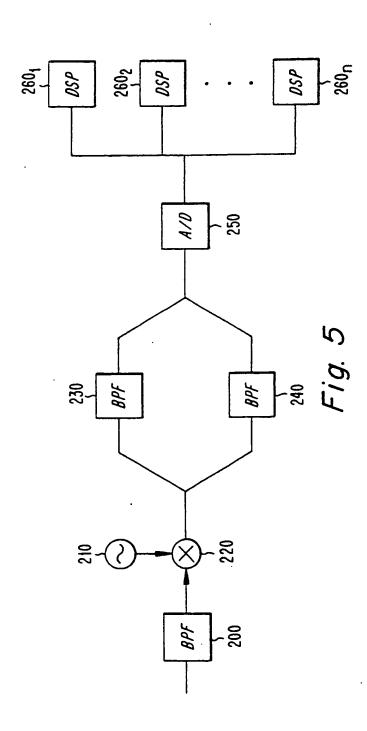
(b) receiving a spectrum of A-, A'- and A''-bands
of the A-band with a mixer and transposing said spectrum
for said A- and A''-bands to a first transposed spectrum
and said spectrum for said A'-band to a second
transposed spectrum; and

(c) aliasing said first and second transposed
spectrums to fulfill the Nyquist criteria when a
sampling frequency of said analog-to-digital converter
is less than twice the bandwidth of said spectrum.

28. A method according to claim 27, wherein said
step (c) aliases down said first transposed spectrum to
an inverted spectrum and said second transposed spectrum
to a non-inverted spectrum.

29. A method according to claim 27, further
comprising the steps of:

(d) receiving said spectrum of said A-, A'- and
A''-bands by a first bandpass filter and passing through
said spectrum of said A-, A'- and A''-bands to said
mixer;

(e) receiving said spectrum of said A- and A''-
bands from said mixer by a second bandpass filter and
passing through said first transposed spectrum to said
analog-to-digital converter; and

(f) receiving said spectrum of said A'-band from
said mixer by a third bandpass filter and passing
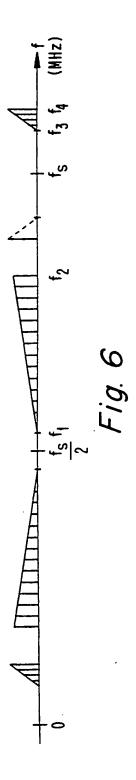through said second transposed spectrum to said analog-
to-digital converter.

Fig. 1
PRIOR ART

Fig. 2
PRIOR ART

Fig. 3

Fig. 4

Fig. 5

Fig. 6

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6   H04B1/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6   H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,5 289 464 (WANG) 22 February 1994 see column 2, line 30 - column 3, line 44; figure 1 ---	1,9,14, 17,22,27
A	US,A,5 436 955 (KAEWELL JR. ET AL) 25 July 1995 see column 1, line 7 - line 54 ---	4,10,14, 19,23,27
A	ELECTRONICS ENGINEERING, vol. 63, no. 771, March 1991, WOOLWICH,LONDON,GB, pages 31-38, XP000223926 OLMSTEAD: "The GSM cellular telephone system and its components" see page 36, column 2, line 6 - page 38, column 2, line 8; figures 2,3 -----	1,9,14, 17,22,27

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

Date of the actual completion of the international search	Date of mailing of the international search report
24 October 1996	1 8. 11. 96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Andersen, J.G.

International Application No

PCT/ᴜE 96/00961

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-5289464	22-02-94	AU-A-	648472	21-04-94
		CA-A-	2100901	22-03-94
		EP-A-	0589594	30-03-94
		JP-A-	6204958	22-07-94
US-A-5436955	25-07-95	NONE		